MULTIMEDIA UNIVERSITY

STUDENT ID NO

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# MULTIMEDIA UNIVERSITY

# FINAL EXAMINATION

**TRIMESTER 3, 2022/2023**

## PSM0325
## INTRODUCTION TO PROBABILITY AND STATISTICS

(Foundation in IT Students only)

4 OCTOBER 2023
9.00 a.m. – 11.00 a.m.
(2 hours)

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**INSTRUCTIONS TO STUDENTS**

1. This question paper consists of **THREE** pages only (excluding the cover page and the appendix on the last page) with **5** Questions only.

2. Answer **ALL FIVE** questions.
   All questions carry equal marks and the distribution of marks for each question is given.

3. Please write all your answers in the Answer Booklet provided.
   All necessary working steps **MUST** be shown.

4. **Statistical Table** is provided.

**Instruction:** Answer **ALL FIVE** questions.

**Question 1 (10 marks)**

(a) The heights of a group of 95 students randomly selected from a class are as follows:

| Height, ($x$) | Number of Students, ($f$) |
|---|---|
| 90 – 95 | 9 |
| 96 – 101 | 18 |
| 102 – 107 | 30 |
| 108 – 113 | 21 |
| 114 – 119 | 12 |
| 120 – 125 | 5 |

**Table 1**

(i) Construct a table based on the guideline provided below with the values of $f$, $m$, $mf$ and $m^2f$ for the all 6 classes of students' heights as shown in **Table 1**:

| $x$ | $f$ | $m$ | $mf$ | $m^2f$ |
|---|---|---|---|---|
| 90 – 95 | 9 | | | |

**(4 marks)**

(ii) Calculate the *mean* height of the students. **(1 mark)**

(iii) Calculate the *standard deviation* of the height of the students. **(3 marks)**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 35 | 23 | 46 | 55 | 34 | 35 | 43 | 42 | 35 | 46 |

(b) Refer to the list of data above and identify the *mode* and the *median*. **(2 marks)**

**Continued...**

**Question 2 (10 marks)**

(a) There are altogether six (6) red marble balls and four (4) blue marble balls in a bag. Five marble balls are selected at random without replacement.

(i) Construct the *probability distribution* for the number of blue marble balls that will be selected. Present your answer in tabular form (in table form). **(4 marks)**

(ii) Find the *probability* that **at most**, three (3) red marble balls are selected. **(1 mark)**

(b) Given a *probability density function* for the continuous random variable $Y$ below:

$$f(y) = \begin{cases} k(y+1), & 0 \le y < 2 \\ 2k, & 2 \le y \le 3 \\ 0, & \textit{elsewhere} \end{cases}$$

(i) Prove that the value of constant $k = 1/6$. **(3 marks)**

(ii) Find $P(1 \le Y \le 2)$. **(2 marks)**

**Question 3 (10 marks)**

(a) Nine bulbs are randomly selected from a large lot of bulbs with "lives" (how long the bulbs last) *normally distributed* with a *mean* of 20 hours and a *standard deviation* of 5 hours. Find the *probability* that the *mean* life of the nine bulbs

(i) is less than 18 hours. **(2 marks)**

(ii) is between 18 hours and 22 hours. **(3 marks)**

(b) In a delivery of microchips, it is known that the number of defective (regarded as spoilt or not good) microchips is 2 out of 10. If 15 microchips are delivered,

(i) what is the *probability* **at least** 5 microchips are defective? **(2 marks)**

(ii) what is the *probability* **exactly** 11 microchips are good? **(2 marks)**

(iii) find the *mean* of good microchips. **(1 mark)**

**Continued...**

**Question 4 (10 marks)**

(a) The *mean* time taken by trainees of a training program to complete a course is at least 18 months. A new teaching method is implemented with a group of trainees in an effort to reduce the time taken by the trainees to complete the course. The *mean* time taken by 80 of these trainees to complete the course was found to be 17 months, with a *standard deviation* of 5 months.

(i) Construct a 99% *confidence interval* for the *mean* time taken by all the trainees to complete the course. **(3 marks)**

(ii) Give your comment on the *confidence interval* if the number of trainees is increased from 80 trainees to 100 trainees. **(1 mark)**

(b) A departmental store with five employees recorded the number of leave (in days) taken by these five employees for the past two years.

23 22 27 30 23

(i) List all possible samples of size three (without replacement) that can be selected from the data and calculate the *mean* for each sample. **(4 marks)**

(ii) Construct the *sampling distribution* of $\bar{x}$. **(2 marks)**

**Question 5 (10 marks)**

(a) Write the *null* and *alternative hypothesis* for the following examples and determine if it is a two-tailed test, a left-tailed test or a right-tailed test.

(i) A marketing agency with 25 sales employees claims that the *mean* annual sales is RM 45,000. A rival agency wants to test the claim. **(2 marks)**

(ii) The weight of the primary student's backpack (with books in it) is at most 5.6 kg. The principal of the school thinks that the backpack is more than 5.6 kg. **(2 marks)**

(b) A private college claimed that the *mean* months their graduates manage to secure a job is at most 6 months after graduation with a *standard deviation* of one month. A committee is set up to verify whether the claim is still valid. A sample of 100 graduates is collected and the sample *mean* is found to be 7.5 months.

(i) Set up the *hypothesis test*, $H_0$ and $H_1$. **(2 marks)**

(ii) Test the claim at 0.05 *significance level*. Can we agree with the statement (or claim) made by the college regarding their graduates securing a job after graduation? **(4 marks)**

**End of Paper**

**Appendix: Keys Formulas**

1. Ungrouped data: $\bar{x} = \dfrac{\sum x}{n} \quad s^2 = \dfrac{1}{n-1}\left(\sum x^2 - \dfrac{\left(\sum x\right)^2}{n}\right)$

2. Grouped data: $\bar{x} = \dfrac{\sum fm}{\sum f} \quad s^2 = \dfrac{1}{\sum f - 1}\left(\sum m^2 f - \dfrac{\left(\sum fm\right)^2}{\sum f}\right)$

3. Grouped data:

$$\text{Median} = L + \left[\frac{\left(\dfrac{\sum f}{2}\right) - F}{f_m}\right] w$$

4. Grouped data:

$$\text{Mode} = L + \left[\frac{f_m - f_b}{\left(f_m - f_b\right) + \left(f_m - f_a\right)}\right] w$$

5. Additive Rule: $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

6. Complement Rule: $P(A') = 1 - P(A)$

7. Conditional Probability: $P(A \mid B) = \dfrac{P(A \cap B)}{P(B)}$

8. Binomial Formula: $P(X = x) = \binom{n}{x} p^x q^{n-x}; \quad \mu = np; \quad \sigma^2 = npq$

9. Poisson Formula: $P(X = x) = \dfrac{(\lambda t)^x e^{-\lambda t}}{x!}; \quad \mu = \sigma^2 = \lambda t$

10. Discrete Random Variables: $E(X) = \sum xp(x) \qquad E(X^2) = \sum x^2 p(x)$

11. Continuous Random Variable: $E(X) = \int_{-\infty}^{\infty} xf(x)dx \qquad E(X^2) = \int_{-\infty}^{\infty} x^2 f(x)dx$

12. Variance of Random Variable: $V(X) = E(X^2) - [E(X)]^2$ ; Standard deviation $= \sqrt{V(X)}$

13. Normal Distribution: Z-score: $z = \dfrac{x - \mu}{\sigma}$

14. Sampling Distribution: Z-score: $z = \dfrac{x - \mu_{\bar{x}}}{\sigma_{\bar{x}}}$; where $\mu_{\bar{x}} = \mu$; $\sigma_{\bar{x}} = \dfrac{\sigma}{\sqrt{n}}$

15. Confidence Interval: $C.I. = \bar{x} \pm z\dfrac{\sigma}{\sqrt{n}}$ or $\bar{x} \pm z\dfrac{s}{\sqrt{n}}$

16. Test statistic: $z^* = \dfrac{\bar{x} - \mu}{\sigma/\sqrt{n}}$ *or* $z^* = \dfrac{\bar{x} - \mu}{s/\sqrt{n}}$